DTU Library

Climate change adaptation to increased urban flood risk: comparing the socio economic efficiency of water sensitive urban design practices with upgrading traditional infrastructure

Arnbjerg-Nielsen, Karsten

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Arnbjerg-Nielsen, K. (2013). *Climate change adaptation to increased urban flood risk: comparing the socio economic efficiency of water sensitive urban design practices with upgrading traditional infrastructure*. Abstract from International Forum on Engineering Decision Making, Shoal Bay, Australia.

Climate change adaptation to increased urban flood risk: comparing the socio-economic efficiency of water sensitive urban design practices with upgrading traditional infrastructure.

Karsten Arnbjerg-Nielsen, Professor, Dept. of Environmental Engineering, Technical University of Denmark

Climatic changes caused by anthropogenic emissions of GHG are expected to lead to increased precipitation extremes in most parts of the world, notably on high latitudes on the Northern Hemisphere. During the last two decades rather large increases in precipitation extremes have already been observed in Denmark, probably to a large extend driven by natural oscillations. Almost all major cities in Denmark have observed a flood in the period 2002 – 2013, and the annual cost of pluvial flooding during this period is more than 10 times higher than what was observed during the 1980ies and 1990ies. This has called for a change in urban planning practices, giving higher focus to flood risk assessments and implementation of risk mitigation measures. These are denoted climate change adaptation plans, because they aim at yielding higher resilience in the urban environment to prepare for a future where the climatic extremes may be even more frequent and severe than what is currently observed.

The call for urban pluvial flood risk assessments is also driven by technological development. The development of airborne LIDAR technologies has enabled development of inundation modeling of urban surfaces with unprecedented precision at low cost. This enables easy incorporation of urban flood risk into urban spatial planning of new developments since the urban fabric and infrastructure can easily be moved. However, when applying the same methods to existing city centers a Pandora's Box of problems emerge. The main questions are asked in many ways and by many stakeholder, but in essence can be reduced to three key questions: 1) How to we assess the value of assets that are at risk (buildings, natural heritage, recreational hotspots), 2) To what level should these assets be protected, and 3) Who should bear the financial burden of protecting these assets?

These questions should be addressed by considering the overall objectives of urban water management. Three principles are important in this context:

- Cities cannot (yet) function without using water was as a means of establishing hygienic barriers between pathogens and humans. Both sanitary sewage and storm water are carriers of such pathogens.
- Retention of water is essential in order to make livable cities by changing physical properties such as enhancing biodiversity, creating recreational areas, and reducing urban heat islands.
- When hydrologic extremes occur, by far the cheapest, most secure, and most efficient way of managing the water is to retain water in or convey water to low-risk areas, typically far from human assets. Retention volumes should be empty in order to serve as spare facilities when conveyance structures are overloaded.

The principles are in direct conflict with each other. While principle 1 and 3 focusses on transportation of water out of the city center in order to create healthy environments and preparing for the extremes, principle 2 wants to retain as much water as possible, thus focusing on other health aspects and storing water for these purposes.

The flood risk assessments in itself points to large societal gains by pointing out which strategies provides the most flood resilient city at minimal cost. However, case studies that combine a flood risk assessment with hedonic valuation of blue and green infrastructure show, that the societal gains obtained by flood resilience may easily be superseded by gains or losses calculated as a function of the public perception of blue and green infrastructure implemented as part of an attempt to create livable cities. Hence it is key to ensure that the three principles are aligned and that the flood resilient city is not a water scarce city, because that will have detrimental impact on the livability. Some of the results also point out, that the public perception of a livable city may not correspond to the perception of urban planning professionals.

The talk will be based on as yet unpublished work as well as the following publications:

Arnbjerg-Nielsen, K. (2011). Past, present, and future design of urban drainage systems with focus on Danish experiences. Water Science and Technology, 63, 3, 527-535. doi: 10.2166/wst.2011.253

Arnbjerg-Nielsen, K. (2012): Quantification of climate change effects on extreme precipitation used for high resolution hydrologic design. Urban Water Journal, 9, 2, 57-65. doi:10.1080/1573062X.2011.630091

Arnbjerg-Nielsen, K., and Fleischer, H.S. (2009): Feasible adaptation strategies for increased risk of flooding in cities due to climate change. Water Science and Technology, 60, 2, 273-281. doi: 10.2166/wst.2009.298

Gregersen, I.B., Sørup, H.J.D., Madsen, H., Rosbjerg, D., Mikkelsen, P.S., and Arnbjerg-Nielsen, K. (2013): Assessing future climatic changes of rainfall extremes at small spatio-temporal scales. Climatic Change, 118, 3-4, 783-797. DOI 10.1007/s10584-012-0669-0

Zhou, Q., Panduro, T.E., Thorsen, B.J., Arnbjerg-Nielsen, K. (2013): Adaption to extreme rainfall with open urban drainage system - An integrated hydrological cost benefit analysis. Environmental Management, 51, 3, 586-601. Open Access. DOI 10.1007/s00267-012-0010-8

Zhou, Q., Mikkelsen, P.S., Halsnæs, K., Arnbjerg-Nielsen, K. (2012): Framework for economic pluvial flood risk assessment considering climate change effects and adaptation benefits. Journal of Hydrology, 414-415, 539-549. doi:10.1016/j.jhydrol.2011.11.031